REMARKS

Claims 1-67 are pending in the application. Claims 1-18 and 24-67 are rejected. Claim 44 has been cancelled. Claims 19-23 are withdrawn due to a restriction requirement. Claims 53, 54, 56, 58, 61 and 62 have been amended for clarity. The drawings are accepted. The Examiner's objections and rejections are addressed below in substantially the same order as in the office action.

Election/Restriction: Applicant hereby confirms the election of 9/20/2004 to prosecute Group I, claims 1-18 and 24-67 with traverse. Claims 19-23 are cancelled herein.

REJECTIONS UNDER 35 USC § 112

Claim 44 is rejected under 35 USC 112 fourth paragraph. Claim 44 is cancelled.

REJECTIONS UNDER 35 USC § 102

Claims 1, 2, 33-36, 39-40, 46-49, 52-53, and 59-62 are rejected under 35 USC § 102(b) as being anticipated by Ruehle (US 4,206,509).

With regard to Claims 1, 40 and 53 the Examiner's position is that Ruehle discloses a method for processing seismic data to estimate a time shift comprising forming a gather of seismic data traces (Column, Lines 5-9). The Examiner's position is that Ruehle discloses cross-correlating seismic data traces included in the gather with a time window to estimate a time shift in the seismic data traces (Column 2, Lines 14-23).

The Ruehle disclosure is directed to "static time shifts." The Ruehle disclosure is not directed to time shifts due to velocity anisotropy. Ruehle does not disclose "cross-correlating seismic data traces included in a gather within a time window to estimate a time shift in the seismic data traces resulting from velocity anisotropy in the earth's subsurface" as claimed in Claim 1 and clearly supported in the disclosure. Therefore, Ruehle does not disclose the method for processing seismic data of Applicants' Claim 1.

In order for a claimed invention to be unpatentable under 35 USC § 102 over a prior art reference, the prior art reference must show each and every limitation of the claimed invention arranged as in the claim. The "cross-correlating seismic data traces included in a gather within a time window to estimate a time shift in the seismic data traces resulting from velocity anisotropy in the earth's subsurface" limitation of Claims 1, 40 and 53 is clearly lacking in the prior art. Accordingly, applicant respectfully submits that Claim 1, 40 and 53 and the Claims that depend upon Claims 1, 40 and 53 are patentable under 35 USC § 102.

Beyond the fact Ruehle fails to teach at least one element of independent Claims 1, 40 and 53, Applicant further submits that no art of record either alone or when combined with other art of record discloses or suggests all the limitations of the claimed invention. The prior art of record along with combinations of the prior art references do not provide or suggest all the limitations of the present invention. Accordingly, applicant respectfully submits that Claims 1, 40 and 53 are allowable over the prior art of record. Further, applicant respectfully submits that Claims 1, 40 and 53 and the claims that depend on Claims 1, 40 and 53 are allowable.

Claims 8-12, and 24-26 are rejected under 35 USC § 102(b) as being anticipated by Thompson et al (US 5,764,516).

The Examiner's position is that Thompson et al discloses "a method for processing seismic data to estimate a time shift resulting from velocity anisotropy in the earth's subsurface." We respectfully disagree that Thompson et al disclose a method for processing seismic data to estimate a time shift resulting from velocity anisotropy in the earth's subsurface. Thompson et al disclose nothing about velocity anisotropy and nothing about estimating time shifts resulting from velocity anisotropy. Thompson et al is directed to a method for correcting seismic data for phase distortion due to near surface effects—that is, to resolving near surface statics problems in seismic data. Velocity anisotropy and statics corrections in seismic data are two well known and quite distinct aspects of data processing that would not be confused by practitioners of the art.

Referring to Claim 8, the Examiner's position is that:

> Thompson et al discloses: a method for processing seismic data to estimate time shift resulting from velocity anisotropy in the earth's subsurface, comprising: forming a gather of seismic data traces; forming a pilot trace by combining a selected plurality of the seismic data traces within a selected time window (col. 21, line 35-36); and cross-correlating a selected seismic data trace included in the gather with the pilot trace to estimate the time shift in the selected seismic data trace resulting from velocity anisotropy in the earth's subsurface (col. 4 lines 22-32; col.21, lines 40-42; figures 6 and 10-11).

The claim limitation the Examiner cites to (col. 21, line 35-36) reads: "generating a first pilot signal corresponding to the plurality of traces in each of a plurality of gathers." Applicants contend that the Thompson et al claim language "the plurality of traces" is clearly supported in Thompson et al specification and is not the "selected plurality," as claimed by Applicants and supported by the application. Instead, "the plurality" of Thompson et al necessarily includes all the traces of each gather for which a pilot signal is formed. Thompson et al disclose producing a pilot trace with reference to Figure 5 number 54. For an explanation see Thompson et al column 7, lines 56 to 60, where they say: "After retrieval of the prestack traces in the CDP gather, the traces are added to one another in process **54**, in the same manner as a conventional stack, to produce a pilot signal S(t) for the gather." As is well known in the art, "the same manner as a conventional stack" is the process of adding all the traces of a gather together, not just a selected plurality of the traces. Therefore, Thompson et al does not anticipate Applicant's invention or Claim 8.

Further, the language the Examiner cites to (col. 4 lines 22-32; col.21, lines 40-42; figures 6 and 10-11) does not support the Examiner's position that Thompson et al cross-correlate selected seismic data traces included in the gather with the pilot trace to estimate the time shift in the selected seismic data trace resulting from velocity anisotropy in the earth's subsurface. Cross-correlation performed in Thompson et al is not directed to estimating the time shift resulting from velocity anisotropy. The Thompson et al explanation of generating the pilot trace as stack of traces (step 82) of Figure 6 is in col. 12 lines 45-48: "Process 82 is then performed *as before* to generate a pilot traces S(t) as the sum of the retrieved prestack traces $T_{ij}(t)$ in the gather" (emphasis added). Of course, the Thompson et al "as before" language is explained with reference to Figure 5, column 7,

lines 56 to 60: "After retrieval of the prestack traces in the CDP gather, the traces are added to one another in process 54, in the same manner as a conventional stack, to produce a pilot signal S(t) for the gather."

Applicant respectfully submits that the "cross-correlating a selected seismic data trace included in the gather with the pilot trace to estimate the time shift in the selected seismic data trace resulting from velocity anisotropy" limitation of Claim 8 is clearly lacking in the prior art. Accordingly, applicant respectfully submits that Claim 8 is allowable.

Beyond the fact Thompson fails to teach at least one element of independent Claim 8, Applicant further submits that no art of record either alone or when combined with other art of record discloses or suggests all the limitations of the claimed invention. Accordingly, applicant respectfully submits that Claim 8 is allowable over the prior art of record.

Referring to Claim 9, the Examiner's position is that:

> Thompson et al discloses: a method for processing seismic data to estimate time shift resulting from velocity anisotropy in the earth's subsurface, comprising: (a) forming a gather of seismic data traces; (b) forming a pilot trace by combining a selected plurality of the seismic data traces within a selected time window (col. 21, line 35-36); and (c) cross-correlating a selected seismic data trace included in the gather with the pilot trace to estimate the time shift in the selected seismic data trace resulting from velocity anisotropy in the earth's subsurface (col. 4 lines 22-32; col.21, lines 40-42; figures 6 and 10-11); and repeating steps (b) and (c) until all seismic data traces within the gather have been cross-correlated with a pilot trace (figures 6 and 10-11).

Applicant has respectfully responded to substantially this argument with respect to Claim 8 above. Applicant respectfully submits that the "cross-correlating a selected seismic data trace included in the gather with the pilot trace to estimate the time shift in the selected seismic data trace resulting from velocity anisotropy" limitation of Claim 9 is clearly lacking in the prior art. Accordingly, applicant respectfully submits that Claim 9 is allowable.

Beyond the fact Thompson fails to teach at least one element of independent Claim 9, Applicant further submits that no art of record either alone or when combined with other art of

record discloses or suggests all the limitations of the claimed invention. Accordingly, applicant respectfully submits that Claim 9 is allowable over the prior art of record.

Referring to Claim 10, the Examiner's position is that:

> Thompson et al discloses: a method for processing seismic data to estimate time shift resulting from velocity anisotropy in the earth's subsurface, comprising: (a) forming a gather of seismic data traces; (b) forming a pilot trace by combining a selected plurality of the seismic data traces within a selected time window (col. 21, line 35-36); and (c) cross-correlating a selected seismic data trace included in the gather with the pilot trace to estimate the time shift in the selected seismic data trace resulting from velocity anisotropy in the earth's subsurface (col. 4 lines 22-32; col.21, lines 40-42; figures 6 and 10-11); and repeating steps (b) and (c) until all seismic data traces within the gather have been cross-correlated with a pilot trace (figures 6 and 10-11); and adjusting each selected seismic data trace by the amount of the estimated time shift in each selected seismic data trace resulting from velocity anisotropy (col. 28, lines 1-3; figure 6 and 10-11).

Applicant has respectfully responded to substantially this argument with respect to Claim 8 above. Applicant respectfully submits that the "cross-correlating a selected seismic data trace included in the gather with the pilot trace to estimate the time shift in the selected seismic data trace resulting from velocity anisotropy" limitations of Claim 10 is clearly lacking in the prior art. Accordingly, applicant respectfully submits that Claim 10 and claims that depend upon Claim 10 are allowable.

Beyond the fact Thompson fails to teach at least one element of independent Claim 10, Applicant further submits that no art of record either alone or when combined with other art of record discloses or suggests all the limitations of the claimed invention. Accordingly, applicant respectfully submits that Claim 10 and claims that depend on Claim 10 are allowable over the prior art of record.

Referring to Claims 11 and 12, the Examiner's position is that:

> Thompson et al discloses a method for processing seismic data to estimate time shift resulting from velocity anisotropy in the earth's subsurface further comprising performing an amplitude variation with incidence angle and azimuth analysis on the adjusted seismic traces, and cites support from Thompson et al column 2, lines 47 to 67 and column 3, lines 1-3.

Respectfully, Thompson et al contains nothing about amplitude variation with incidence angle nor amplitude variation with azimuth, whether adjusted or not, in the cited passages, and not anywhere else in Thompson et al disclosure. Therefore, Thompson et al does not anticipate Applicant's invention or Claims 11 and 12.

In order for a claimed invention to be unpatentable under 35 USC § 102 over a prior art reference, the prior art reference must show each and every limitation of the claimed invention arranged as in the claim. The "method of claim 10 further comprising performing an amplitude variation with incidence angle analysis on said adjusted seismic data traces" limitation of original Claim 11 and the "method of claim 10 further comprising performing an amplitude variation with azimuth analysis on said adjusted seismic data traces" limitation of original Claim 12 are both clearly lacking in the prior art of record. Accordingly, applicant respectfully submits that these claims are allowable.

Applicant further submits that no art of record either alone or when combined with other art of record discloses or suggests all the limitations of the claimed invention. The suggestion to combine these limitations is clearly lacking in the prior art of the present case. Accordingly, applicant respectfully submits that Claims 11 and 12 are allowable.

Referring to Claim 24 the Examiner's position is that:

> Thompson et al discloses a digital computer programmed to utilize seismic data traces obtained over a region of the earth's subsurface to perform a process comprising the steps of: forming a gather of seismic data traces; forming a pilot trace by combining a selected plurality of the seismic data traces within a selected time window (col. 23, line 26-30); and cross-correlating a selected seismic data trace included in the gather with the pilot trace to estimate the time shift in the selected seismic data traces resulting from the velocity anisotropy in the earth's subsurface (col. 23, lines 34-36).

The claim limitation the Examiner refers to reads: "generating a first pilot signal corresponding to the plurality of traces in each of a plurality of gathers." Applicants contend that the Thompson et al claim language "the plurality of traces" is not a "selected plurality," but instead "the

plurality" necessarily includes all the traces of each gather for which a pilot signal is formed. See discussion relative to Claim 8 above.

Further, the Thompson et al claim element at col. 23, lines 34-36 "correlating each of the plurality of traces with the filtered pilot signal to produce a correlation function for each trace" is not the disclosure of "cross-correlating a selected seismic data included in the gather with the pilot trace to estimate the time shift in the selected seismic data traces resulting from the velocity anisotropy in the earth's subsurface." The Thompson correlation function is a function, and is not an estimate of a time shift, much less a shift resulting from velocity anisotropy. The time adjustments that are in the Thompson et al disclosure are directed to compensation for near surface static effects not velocity anisotropy.

Applicant respectfully submits that the "cross-correlating a selected seismic data trace included in said gather with said pilot trace to estimate the time shift in said selected seismic data trace resulting from velocity anisotropy in the earth's subsurface" limitation of Claim 24 is clearly lacking in the prior art. Accordingly, applicant respectfully submits that Claim 24 is allowable.

Beyond the fact Thompson fails to teach at least one element of independent Claim 24, Applicant further submits that no art of record either alone or when combined with other art of record discloses or suggests all the limitations of the claimed invention. Accordingly, applicant respectfully submits that Claim 24 is allowable.

Referring to Claim 25 the Examiner's position is that:

> Thompson et al discloses a device which is readable by a digital computer having instructions defining the following process and instructions to the computer to perform the process: forming a gather of seismic data traces; forming a pilot trace by combining a selected plurality of the seismic data traces within a selected time window (col. 25, line 27-31); and cross-correlating a selected seismic data trace included in the gather with the pilot trace to estimate the time shift in the selected seismic data trace resulting from velocity anisotropy in the earth's subsurface (col. 25, line 35-36).

Applicant has respectfully responded to substantially this argument with respect to Claim 24 above. Applicant respectfully submits that the "cross-correlating a selected seismic data trace

included in said gather with said pilot trace to estimate the time shift in said selected seismic data trace resulting from velocity anisotropy in the earth's subsurface" limitation of Claim 25 is clearly lacking in the prior art. Accordingly, applicant respectfully submits that Claim 25 and the claim depending from Claim 25 is allowable.

Beyond the fact Thompson fails to teach at least one element of independent Claim 25, Applicant further submits that no art of record either alone or when combined with other art of record discloses or suggests all the limitations of the claimed invention. Accordingly, applicant respectfully submits that Claim 25 and the claim depending from Claim 25 is allowable.

REJECTIONS UNDER 35 USC § 103

Claims 3, 29, 30, 37, 43, 51, 56 and 57 are rejected under 35 USC § 103(a) as being unpatentable over Ruehle (US 4,206,509) in view of Crider et al. (US 6,263,284).

In order to sustain an obviousness rejection under 35 USC § 103, two requirements must be met. First, the prior art of record must disclose all the limitations of the claimed invention. Ruehle and Crider et al together and in combination do not disclose or suggest all the limitations of the claimed invention. Applicant submits that no art of record either alone or when combined with other art of record discloses or suggests all the limitations of the claimed invention. There is no suggestion to combine the prior art of the present case to form the present invention. Accordingly, applicant respectfully submits that these claims are allowable.

With regard to claim 3, the Examiner's position is that:

> Ruehle discloses adjusting seismic data traces by an amount estimated from a determined time shift. Ruehle does not disclose performing an amplitude variation with incidence angle analysis on the adjusted seismic traces. US Patent No. 6,263,284 to Crider et al discloses performing an amplitude variation with incidence angle on adjusted seismic traces (Column 12, Lines 45-65). It would have been obvious to one skilled in the art to modify the time-shifted traces disclose by Ruehle to include performing an amplitude variation based on incidence angle as taught by Crider in order to remove unwanted reflections from the data.

First as to Ruehle: As we have explained in reference to Claim 1 above, Ruehle does not disclose estimating a time shift resulting from velocity anisotropy. The Ruehle disclosure is clearly directed to forming static corrected seismic record sections due to near surface effects. Therefore, at least one element of Applicants' claimed invention is not disclosed by Ruehle.

As to Crider et al: Crider et al does not disclose any processing procedure with adjusted traces. Adjusted traces are not relevant to purpose of the Crider et al invention, which is the identification and extraction or suppression of primary reflections, converted mode events and multiples.

Claim 3 is allowable for at least the reasons Claim 1 is allowable. Additionally, the prior art of record and the proposed combination of Ruehle and Crider fails to teach all the limitations of the claimed invention. Accordingly, Applicant respectfully submits that Claim 3 is allowable.

With regard to claim 29, the Examiner's position is that:

> Ruehle does not disclose utilizing the estimated time shift to calculate the amplitude variation with incidence angle in seismic data traces. Crider discloses performing an amplitude variation with incidence angle on adjusted seismic traces (Column 12, Lines 45-65). It would have been obvious to one skilled in the art to modify the time-shifted traces disclose by Ruehle to include performing an amplitude variation based on incidence angle as taught by Crider in order to remove unwanted reflections from the data.

As Applicant respectfully points out with respect to Claim 3 above, Crider does not disclose performing an amplitude variation with incidence angle on adjusted seismic traces. Claim 29 is allowable for at least the reasons Claim 1 is allowable. Additionally, the prior art of record and the proposed combination of Ruehle and Crider fails to teach all the limitations of the claimed invention. Accordingly, Applicant respectfully submits that Claim 29 is allowable.

With regard to claim 30, Examiner's position is that:

> Ruehle does not disclose using a least squares analysis process to utilize the estimated time shift to calculate an amplitude variation with incidence angle. Crider discloses performing an amplitude variation with incidence angle on adjusted seismic traces (Column 12, Lines 45-65). Crider further discloses applying a least squares analysis process to reflection coefficient (amplitude) and to angle of incidence (Column 10, Lines 33-60). It would have been obvious to modify Ruehle to include

performing a least squares analysis process on amplitude variation with incidence angle data as taught by Crider in order to obtain best fit values for the data.

As Applicant respectfully points out with respect to Claim 3 above, Crider does not disclose performing an amplitude variation with incidence angle on adjusted seismic traces. Claim 30 is allowable for at least the reasons Claim 1 is allowable. Additionally, the prior art of record and the proposed combination of Ruehle and Crider fail to teach all the limitations of the claimed invention. Accordingly, Applicant respectfully submits that Claim 30 is allowable.

With regards to claim 37 the same reasons apply as for claims 29 and 30. Ruehle does not disclose estimating a time shift resulting from velocity anisotropy. The Ruehle disclosure is directed to forming static corrected seismic sections due to near surface effects, not velocity anisotropy. Claim 37 is allowable for at least the reasons Claim 1, 35 and 36 are allowable. Additionally, the prior art of record and the proposed combination of Ruehle and Crider fails to teach all the limitations of the claimed invention. Accordingly, Applicant respectfully submits that Claim 37 is allowable.

With regard to claim 43, the Examiner's position is that:

> Ruehle discloses the computer of claim 40, but does not disclose applying a least squares analysis process to the time shift of the seismic data traces to calculate an amplitude variation with incidence angle value. Crider discloses performing an amplitude variation with incidence angle on adjusted seismic traces (Column 12, Lines 45-65). It would have been obvious to one skilled in the art to modify the time-shifted traces disclose by Ruehle to include performing an amplitude variation based on incidence angle as taught by Crider in order to remove unwanted reflections from the data. Crider further discloses applying a least squares analysis process to reflection coefficient (amplitude) and to angle of incidence (Column 10, Lines 33-60). It would have been obvious to modify Ruehle to include performing a least squares analysis process with the estimated time shifts used to calculate amplitude variation with incidence angle data as taught by Crider in order to obtain best fit values for the data with the computer.

Ruehle does not disclose the computer system of Applicants' Claim 40. Ruehle does not disclose "cross-correlating seismic data traces included in a gather within a time window to estimate a time shift in the seismic data traces resulting from velocity anisotropy in the earth's subsurface" as

claimed in Applicants' Claim 40. Ruehle discloses time shifts to form static corrected seismic record sections. Ruehle has nothing to do with velocity anisotropy.

Claim 43 is allowable for at least the reasons Claim 40 is allowable. Additionally, the prior art of record and the proposed combination of Ruehle and Crider fail to teach all the limitation of the claimed invention. Accordingly, Applicant respectfully submits that Claim 43 is allowable.

With regard to claim 51, the Examiner's position is that:

> Ruehle discloses the digital computer of claim 49, but does not disclose further programming it to perform an amplitude variation with incidence angle analysis on the adjusted seismic traces. Crider discloses performing an amplitude variation with incidence angle on adjusted seismic traces (Column 12, Lines 45-65). It would have been obvious to one skilled in the art to modify the time-shifted traces disclose by Ruehle to include performing an amplitude variation based on incidence angle as taught by Crider in order to remove unwanted reflections from the data.

Because Ruehle does not disclose the computer system of Applicants' Claim 40, Ruehle does not disclose the computer system of Claim 48, Claim 49 or Claim 51. Claim 51 is allowable for at least the reasons any claim from which it depends is allowable. Additionally, the prior art of record and the proposed combination of Ruehle and Crider fail to teach all the limitations of the claimed invention. Accordingly, Applicant respectfully submits that Claim 51 is allowable.

With regards to claims 56 and 57, the Examiner's position is that:

> Ruehle discloses the system of claim 53, but does not disclose utilizing the time shift of the data traces to calculate the amplitude variation with incidence angle. He also does not disclose utilizing the estimated time shift comprising a least squares analysis process. Crider discloses performing an amplitude variation with incidence angle on adjusted seismic traces (Column 12, Lines 45-65). It would have been obvious to one skilled in the art to modify the time-shifted traces disclose by Ruehle to include performing an amplitude variation based on incidence angle as taught by Crider in order to remove unwanted reflections from the data. Crider further discloses applying a least squares analysis process to reflection coefficient (amplitude) and to angle of incidence (Column 10, Lines 33-60). It would have been obvious to modify Ruehle to include performing a least squares analysis process with the estimated time shifts used to calculate amplitude variation with incidence angle data as taught by Crider in order to obtain best fit values for the data with the computer.

Ruehle does not disclose the computer system of Applicants' Claim 53. Ruehle does not disclose "cross-correlating seismic data traces included in said gather within a time window to estimate a time shift in the seismic data traces resulting from velocity anisotropy in the earth's subsurface" as claimed in Claim 53. Ruehle discloses time shifts to form static corrected seismic record sections. Ruehle has nothing to do with velocity anisotropy.

As Applicant respectfully points out with respect to Claim 3 above, Crider does not disclose performing an amplitude variation with incidence angle on adjusted seismic traces. Claim 56 is allowable for at least the reasons Claim 53 is allowable. Claim 57 is allowable for at least the reasons Claim 56 is allowable. Additionally, the prior art of record and the proposed combination of Ruehle and Crider fail to teach all the limitations of the claimed invention. Accordingly, Applicant respectfully submits that Claims 56 and 57 are allowable.

Claims 3, 29, 37 and 51 are rejected under 35 U.S.C 103(a) as being unpatentable over Ruehle in view of Herkenhoff.

In order to sustain an obviousness rejection under 35 USC § 103, two requirements must be met. First, the prior art of record must disclose all the limitations of the claimed invention. Ruehle and Herkenhoff et al together and in combination do not disclose or suggest all the limitations of the claimed invention. Applicant submits that no art of record either alone or when combined with other art of record discloses or suggests all the limitations of the claimed invention. The prior art of record along with a combination of Ruehle and Herkenhoff does not provide or suggest all the limitations of the present invention. There is no suggestion to combine the prior art of the present case to form the present invention. Accordingly, applicant respectfully submits that these claims are allowable.

With regard to claim 3 the Examiner's position is that:

> Ruehle discloses adjusting seismic data traces by an amount estimated from a determined time shift. Ruehle does not disclose performing an amplitude variation with incidence angle analysis on the adjusted seismic traces. Herkenhoff discloses performing an amplitude variation with incidence angle analysis on adjusted seismic data traces (Fig. 3, 4, 7, 8). It would have been obvious to modify Ruehle to include performing amplitude variation based on incidence angle as taught by Herkenhoff in

> order to easily follow changes in amplitude that would allow determination of characteristics of a hydrocarbon well.

For the reasons pointed out above, Ruehle does not anticipate Applicants' invention. Ruehle does not disclose elements claimed in Applicants' Claim 1 from which Claim 3 depends. As to Herkenhoff et al: Herkenhoff et al does not disclose performing an amplitude variation with incidence angle analysis on adjusted seismic data traces (Fig. 3, 4, 7, 8). Herkenhoff et al direct their disclosure to a method of determining variations in amplitude over source to receiver offsets (see Col. 10, lines 35-65). Herkenhoff et al speak to the theoretical reasons that amplitude variations with offset occur and their Figures 3 and 4 illustrate theoretical models. The theoretical model suggests that an amplitude variation with incidence angle effect should occur. Herkenhoff et al use the fact that this amplitude variation with incidence angle effect should manifest as a variation with amplitude over different offset ranges. However, an analysis of amplitude variations occurring over offset ranges is not the same as an analysis of amplitude variation with incidence angle analysis on adjusted seismic data traces, which analysis Herkenhoff does not disclose.

Claim 3 is allowable for at least the reasons Claim 1 is allowable. Additionally, the prior art of record and the proposed combination of Ruehle and Herkenhoff fails to teach or suggest all the limitations of the claimed invention. Accordingly, Applicant respectfully submits that Claim 3 is allowable.

With regard to claim 29 the Examiner's position is that:

> Ruehle discloses adjusting seismic data traces by an amount estimated from a determined time shift. Ruehle does not disclose performing an amplitude variation with incidence angle analysis on the adjusted seismic traces. Herkenhoff discloses performing an amplitude variation with incidence angle analysis on adjusted seismic data traces (Fig. 3, 4, 7, 8). It would have been obvious to modify Ruehle to include performing amplitude variation based on incidence angle as taught by Herkenhoff in order to easily follow changes in amplitude that would allow determination of characteristics of a hydrocarbon well.

Applicant has respectfully responded to substantially this argument with respect to Claim 3 above. Claim 29 is allowable for at least the reasons Claim 1 is allowable. Additionally, the prior art

of record and the proposed combination of Ruehle and Herkenhoff et al fails to teach all the limitations of the claimed invention. Accordingly, Applicant respectfully submits that Claim 29 is allowable.

With regard to claim 37 the Examiner's position is that:

> Ruehle discloses adjusting seismic data traces by an amount estimated from a determined time shift. Ruehle does not disclose performing an amplitude variation with incidence angle analysis on the adjusted seismic traces. Herkenhoff discloses performing an amplitude variation with incidence angle analysis on adjusted seismic data traces (Fig. 3, 4, 7, 8). It would have been obvious to modify Ruehle to include performing amplitude variation based on incidence angle as taught by Herkenhoff in order to easily follow changes in amplitude that would allow determination of characteristics of a hydrocarbon well.

Reuhle and Herkenhoff et al have been addressed with respect to Claim 29 and shown not to disclose separately or in combination all the elements of the claimed invention. Claim 37 is allowable for at least the reasons any claim from it depends is allowable. Additionally, the prior art of record and the proposed combination of Ruehle and Herkenhoff et al fails to teach all the limitations of the claimed invention. Accordingly, Applicant respectfully submits that Claim 37 is allowable.

With regard to claim 51 the Examiner's position is that:

> Ruehle discloses the digital computer of claim 49, but does not disclose further programming it to perform an amplitude variation with incidence angle analysis on the adjusted seismic traces. Herkenhoff discloses performing an amplitude variation with incidence angle analysis on adjusted seismic data traces (Fig. 3, 4, 7, 8). It would have been obvious to modify Ruehle to include performing amplitude variation based on incidence angle as taught by Herkenhoff in order to easily follow changes in amplitude that would allow determination of characteristics of a hydrocarbon well.

Reuhle and Herkenhoff et al have been addressed with respect to Claim 29 and shown not to disclose separately or in combination all the elements of the claimed invention. Claim 51 is allowable for at least the reasons any claim from it depends is allowable. Additionally, the prior art of record and the proposed combination of Ruehle and Herkenhoff et al fails to teach all the

limitations of the claimed invention. Accordingly, Applicant respectfully submits that Claim 51 is allowable.

Claims 4, 27, 31, 38, 41, 45, 50, 54, and 58 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ruehle in view of Ruger.

Ruehle and Ruger are directed to two very different problems. Ruehle is directed to surface statics problems. Ruger is a theoretical discussion of anisotropic velocity modeling that may suggest seismic wave behavior in the earth. It would not have been obvious to combine a surface statics solution with a discussion of velocity anisotropy modelling, and there is no motivation is either reference combine them.

In order to sustain an obviousness rejection under 35 USC § 103, two requirements must be met. First, the prior art of record must disclose all the limitations of the claimed invention. Ruehle and Ruger et al together and in combination do not disclose or suggest all the limitations of the claimed invention. The prior art of record does not contain and the proposed combination does not teach all the limitations of the claimed invention. There is no suggestion to combine the prior art of the present case to form the present invention. Accordingly, applicant respectfully submits that these claims are allowable.

With regard to claims 4, 27, 31 and 38 the Examiner's position is that:

> Ruehle does not disclose performing an amplitude variation with azimuth analysis on adjusted seismic data traces. "Variation of P-wave reflectivity with offset and azimuth in anisotropic media" by **Ruger discloses performing amplitude variation with azimuthal analysis on adjusted seismic data (emphasis added)**. It would have been obvious to modify the time shifted traces of Ruehle to include performing amplitude variation with azimuth analysis as taught by Ruger in order to gain information relating amplitude to the coordinate system of the underground formations.

Ruger is a theoretical analysis based on mathematical equations of the effects that should be manifested in seismic data if anisotropic effects are present. Ruger does not disclose performing

amplitude variation with azimuthal analysis on adjusted seismic data. There are no 'adjusted seismic data' in Ruger. Adjusted seismic data are not addressed in Ruger.

Claims 4, 27, 31 and 38 are allowable for at least the reasons claims from which they depend are allowable. Additionally, the prior art of record and the proposed combination of Ruehle and Ruger fails to teach or suggest all the limitations of the claimed invention. Accordingly, Applicant respectfully submits that Claims 4, 27, 31 and 38 are allowable.

With regard to claim 41, the Examiner's position is that:

> Ruehle discloses the digital computer of claim 40, but does not disclose programming it to perform a process comprising utilizing the estimated time shift of the seismic data traces to calculate an amplitude variation with azimuth value or a velocity variation with azimuth value in the seismic traces. Ruger discloses analyzing the reflection coefficient as a function of azimuth (page 939). Since the reflection coefficient is directly related to the amplitude, this is read as calculating the amplitude variation with azimuth. It would have been obvious to modify the digital computer system of Ruehle to include **utilizing the estimated time shift to calculate an amplitude variation with azimuth as taught by Ruger (emphasis added)** in order to have the computer program give information about the natural coordinate system of the underground formation (Ruger, page 940) (emphasis added).

Ruehle does not disclose all the limitations claimed by Applicants' Claim 40, therefore, Ruehle does not disclose the computer system of Claim 40—see discussion of claim 40; therefore Claim 41 is allowable for at least any reasons 40 is allowable.

Ruger is a theoretical analysis of the effects that may be manifested in seismic data if anisotropic effects are present. Ruger does not disclose performing amplitude variation utilizing the estimated shift of seismic data traces. Estimated time shifts in seismic data are not taught in Ruger.

Claim 41 is allowable for at least the reasons Claim 40 is allowable. Additionally, the prior art of record and the proposed combination of Ruehle and Ruger fails to teach or suggest all the limitations of the claimed invention. Accordingly, Applicant respectfully submits that Claims 41 is allowable.

With regard to claims 45, the Examiner's position is that:

> Ruehle discloses the digital computer of claim 40, but does not disclose utilizing the estimated time shift, reflection coefficient, source-receiver azimuth angle, and

> incidence angle for the seismic data traces to calculate an amplitude variation with azimuth. Ruger discloses utilizing reflection coefficient, source-receiver azimuth angle, and incidence angle for the seismic data traces to calculate an amplitude variation with azimuth (Abstract, page 939). It would have been obvious to modify Ruehle to include utilizing the estimated time shift and reflection coefficients to include utilizing the source-receiver azimuth angle as taught by Ruger to calculate an amplitude variation with azimuthal angle in order to help find the orientation of the natural coordinate system of the subsurface (Ruger, page 940).

Claim 45 is allowable for at least the reasons Claim 40 is allowable. Additionally, the prior art of record and the proposed combination of Ruehle and Ruger fails to teach or suggest all the limitations of the claimed invention. It would not be obvious to combine Ruehle, directed to statics, with Ruger, a theoretical discussion of anisotropy. Accordingly, Applicant respectfully submits that Claims 45 is allowable.

With regard to claim 50, the Examiner's position is that:

> Ruehle discloses the computer of claim 49, but does not disclose that it is further programmed to perform a process utilizing the estimated time shift of the seismic data traces to calculate an amplitude variation with azimuth or a velocity variation with azimuth value. Ruger discloses variation of P-wave reflectivity with offset and azimuth that deals with amplitude variation. It would have been obvious to modify Ruehle to utilize the estimated time shift of the seismic data traces to calculate an amplitude variation with azimuth as taught by Ruger in order to check the accuracy of the data taken for a certain underground structure.

Claim 50 is allowable for at least the reasons Claim 49 is allowable. Additionally, the prior art of record and the proposed combination of Ruehle and Ruger fails to teach or suggest all the limitations of the claimed invention. It would not be obvious to combine a Ruehle, directed to statics, with Ruger, a theoretical discussion of anisotropy. Accordingly, Applicant respectfully submits that Claim 50 is allowable.

With regard to claim 54, the Examiner's position is that:

> Ruehle discloses the system of claim 53, but does not disclose utilizing the estimated time shift of the seismic data traces to calculate an amplitude variation with azimuth or a velocity variation with azimuth value. Ruger discloses variation of P-wave reflectivity with offset and azimuth that deals with amplitude variation. It would have been obvious to modify Ruehle to utilize the estimated time shift of the seismic data

> traces to calculate an amplitude variation with azimuth as taught by Ruger in order to check the accuracy of the data taken for a certain underground structure.

Claim 54 is allowable for at least the reasons Claim 53 is allowable. Additionally, the prior art of record and the proposed combination of Ruehle and Ruger fails to teach or suggest all the limitations of the claimed invention. It would not be obvious to combine a Ruehle, directed to statics, with Ruger, a theoretical discussion of anisotropy. Accordingly, Applicant respectfully submits that Claim 54 is allowable.

With regard to claim 58, the Examiner's position is that:

> Ruehle discloses the system of claim 53, but does not disclose utilizing the estimated time shift, reflection coefficient, source-receiver azimuth angle, and incidence angle for the seismic data traces to calculate an amplitude variation with azimuth. Ruger discloses utilizing reflection coefficient, source-receiver azimuth angle, and incidence angle for the seismic data traces to calculate an amplitude variation with azimuth (Abstract, page 939). It would have been obvious to modify Ruehle to include utilizing the estimated time shift and reflection coefficients to include utilizing the source-receiver azimuth angle as taught by Ruger to calculate an amplitude variation with azimuthal angle in order to help find the orientation of the natural coordinate system of the subsurface (Ruger, page 940).

Respectfully, Applicant fails to see in the Abstract where Ruger discloses "utilizing reflection coefficient, source-receiver azimuth angle, and incidence angle for the seismic data traces to calculate an amplitude variation with azimuth." Ruger analyzes data models that have been constructed from equations, not actual seismic data. As Ruger says: "The simple relationships between the reflection amplitudes and anisotropic coefficients given here can be regarded as helpful rules of thumb in quickly evaluating the importance of anisotropy in a particular play, integrating results of NMO and shear-wave-splitting analyses, planning data acquisition, and guiding more advanced numerical amplitude-inversion procedures." As this makes clear, Ruger's hand waving, detailed and impressive as it is, is telling us about expected seismic wave behavior, not about actual analysis of seismic data.

Claim 58 is allowable for at least the reasons Claim 53 is allowable. Additionally, the prior art of record and the proposed combination of Ruehle and Ruger fails to teach or suggest all the

limitations of the claimed invention. It would not be obvious to combine a Ruehle, directed to statics, with Ruger, a theoretical discussion of anisotropy. Accordingly, Applicant respectfully submits that Claim 58 is allowable.

Claims 5, 28, 32, 42, 55, and 63-67 are rejected under 35 USC § 103(a) as being unpatentable over Ruehle (US 4,206,509) in view of Crider et al. (US 6,263,284) and Ruger, or Ruehle (US 4,206,509) in view of Herkenhoff (US 4,570,246) and Ruger.

In order to sustain an obviousness rejection under 35 USC § 103, two requirements must be met. First, the prior art of record must disclose all the limitations of the claimed invention. As has been established above, these references do not contain all the elements of the claimed invention. Neither does the prior art of record along with any proposed combinations of these references provide all the elements of the present invention. Ruehle, Crider and Ruger together and in combination do not teach all the limitations of the claimed invention. Ruehle, Herkenhoff et al and Ruger together and in combination do not teach all the limitations of the claimed invention. Additionally, there must be a suggestion in the prior art of record to combine the limitations as in the claimed invention. The suggestion to combine these limitations is clearly lacking in the prior art of the present case. Accordingly, applicant respectfully submits that Claims 5, 28, 32, 42 and 55 are allowable. Additionally, Claims 5, 28, 32, 42 and 55 are allowable for at least the reasons the claims from which they depend are allowable.

With regard to claim 63, the Examiner's position is that:

> Ruehle discloses a method for processing seismic data to estimate a time shift comprising forming a gather of seismic data traces (Column 2, Lines 5-9). He discloses cross-correlating seismic data traces included in the gather within a time window to estimate a time shift in the seismic data traces (Column 2, Lines 14-23). He does not disclose utilizing the estimated time shift of the seismic data traces to calculate an amplitude variation with incidence angle, an amplitude variation with azimuth or a velocity variation with azimuth value. Ruger discloses variation of P-wave reflectivity with offset and azimuth that deals with amplitude variation. It would have been obvious to modify Ruehle to utilize the estimated time shift of the seismic data traces to calculate an amplitude variation with azimuth as taught by Ruger in order to check the accuracy of the data taken for a certain underground

> structure. Herkenhoff discloses performing an amplitude variation with incidence angle analysis on adjusted seismic data traces (Fig. 3, 4, 7, 8). It would have been obvious to modify Ruehle to include performing amplitude variation based on incidence angle as taught by Herkenhoff in order to easily follow changes in amplitude that would allow determination of characteristics of a hydrocarbon well. Crider discloses performing an amplitude variation with incidence angle on adjusted seismic traces (Column 12, Lines 45-65). It would have been obvious to one skilled in the art to modify the time-shifted traces disclose by Ruehle to include performing an amplitude variation based on incidence angle as taught by Crider in order to remove unwanted reflections from the data.

Respectfully, it is not obvious, and none of the references provide motivation for, combining surface statics solution (Ruehle) with a theoretical discussion of anisotropy models (Ruger) that contains no actual seismic data, much less time shifted seismic data, to form the claimed invention. Ruehle has nothing to do with anisotropy. "Anisotropy" nowhere appears in Ruehle. The proposed combination fails to teach or suggest all the elements of the claimed invention.

As Applicant has illustrated above, Herkenhoff does not disclose performing an amplitude variation with incidence angle analysis on adjusted seismic data traces. It is not obvious, and none of the references provide motivation for, combining a surface statics solution (Ruehle) with an amplitude versus offset disclosure (Herkenhoff) to form the claimed invention. The proposed combination fails to teach or suggest all the elements of the claimed invention.

It is not obvious, and none of the references provide motivation for, combining surface a statics solution (Ruehle) with an AVO-type analysis (Crider) to form the claimed invention. We note that the words 'anisotropy' and 'anisotropic' do not appear in either reference. The proposed combination fails to teach or suggest all the elements of the claimed invention. Accordingly, Applicant respectfully submits that Claim 63 is allowable.

As regards Claims 64-67, these claims are allowable for at least the reasons Claim 63 is allowable. Additionally, the prior art of record and the proposed combination of Ruehle in view of Crider et al and Ruger fails to teach or suggest all the limitations of the claimed invention. The prior art of record and the proposed combination of Ruehle in view of Herkenhoff and Ruger fails to teach or suggest all the limitations of the claimed invention. Contrary to the Examiner's assertions, Ruehle

does not "disclose using the estimated time shift in the seismic data traces for determining an anisotropy time shift correction" for the data. Neither does Ruehle "disclose applying the anisotropy time shift correction to the seismic data traces." The word anisotropy and its equivalents do not appear anywhere in Ruehle. Accordingly, Applicant respectfully submits that Claims 64-67 are allowable.

Claim 6 is rejected under 35 USC § 103(a) as being unpatentable over Ruehle (US 4,206,509) in view of Byun (US 5,933,789).

With regard to claim 6, the Examiner's position is that:

> Ruehle does not disclose applying a least squares analysis process to the time shift of the seismic data traces. Byun discloses performing a least squares best-fit analysis of the time shifts (Column 7 Line 51 - Column 8 Line 4). It would have been obvious to modify Ruehle to include a best fit analysis of the time shift values as taught by Byun in order to optimize the accuracy of the correction of velocity functions for the traces.

Claim 6 is allowable for at least the reasons Claim 1 is allowable. Additionally, the prior art of record and the proposed combination of Ruehle and Byun et al fails to teach or suggest all the limitations of the claimed invention. Additionally, Byun et al does not disclose a least squares analysis process anywhere in the disclosure (see discussion below with respect to Claims 17 and 18). It would not be obvious to combine Ruehle, directed to statics, with Byun et al, also directed to statics, to form Claim 6. Neither reference teaches anything about velocity variation with azimuth. The words azimuth and azimuthal nowhere appear in either reference. Accordingly, Applicant respectfully submits that Claim 6 is allowable.

Claims 7 (sic) (17?) and 18 are rejected under 35 USC § 103(a) as being unpatentable over Ruehle (US 4,206,509) in view of Crider et al. (US 6,263,284) and Byun (US 5,933,789).

The Examiner's position **with regard to claim 17 and 18** is that

> Ruehle discloses forming a gather of seismic traces and forming a pilot trace by combining a selected plurality of seismic traces within a time window (Column 2, Lines 1-20). Ruehle discloses determining a surface consistent statics correction for

seismic data traces (Column 1, lines 39-46 and Column 2, Lines 20-26). Ruehle discloses cross-correlating successive selected seismic data traces in the gather to estimate a time shift in the seismic data traces included in the gather (Abstract). He does not disclose applying a least squares analysis process to the time shifts of the seismic data traces to calculate velocity variation with azimuth. Ruehle does disclose calculating time shifts in the seismic data traces and applying the time shifts to the data traces (Column 2, Lines 15-25). Ruehle does not disclose applying a least squares analysis process to reflection coefficient, source-receiver azimuth, and incidence angle data for the seismic traces. Byun discloses performing a least squares best-fit analysis of the time shifts (Column 7 Line 51 - Column 8 Line 4). It would have been obvious to modify Ruehle to include a best fit analysis of the time shift values as taught by Byun in order to optimize the accuracy of the correction of velocity functions for the traces. Crider discloses applying a least squares analysis process to reflection coefficient and to incidence angle data. Although Crider does not disclose performing a least squares analysis process to source-receiver azimuth, it would have been obvious to include source-receiver azimuth in the least squares analysis taught by Crider if that were one of the parameters of interest. Crider discloses performing an amplitude variation with incidence angle on adjusted seismic traces (Column 12, Lines 45-65). It would have been obvious to one skilled in the art to modify the time-shifted traces disclosed by Ruehle to include performing an amplitude variation based on incidence angle as taught by Crider in order to remove unwanted reflections from the data. Crider further discloses applying a least squares analysis process to reflection coefficient (amplitude) and to angle of incidence (Column 10, Lines 33-60). It would have been obvious to modify Ruehle to include performing a least squares analysis process with the estimated time shifts used to calculate amplitude variation with incidence angle data as taught by Crider in order to obtain best fit values for the data.

The Examiner asserts: "It would have been obvious to modify Ruehle to include a best fit analysis of the time shift values as taught by Byun in order to optimize the accuracy of the correction of velocity functions for the traces." Respectfully, this is not correct. Byun et al does not disclose a least squares analysis process anywhere in the disclosure. What Byun et al does disclose fully and clearly explains is a "best fit" procedure for choosing Normal Moveout (NMO) velocity corrections:

> Conventional derivation of the stacking velocity V_g for NMO correction is typically done in a "best-fit" manner to optimize the accuracy of the correction among all of the traces in the gather. For example, a series of corrections based upon multiple trial stacking velocities may be applied to a gather of traces. Semblance, or correlation, analysis is then applied among the traces over limited time windows (corresponding to the localities of individual reflection

> events), and plotted as a function of time T_0 and velocity V_s. The best-fit stacking velocities for each event are then selected at the values yielding the highest semblance value, resulting in a stacking velocity time function $V_s(T_0)$. NMO correction may then be readily applied to each reflection event in each trace, using the stacking velocity function derived from the semblance analysis. **(Column 2, lines 46-60, of Byun)**

Byun et al's "best fit" procedure for choosing Normal Moveout (NMO) velocity corrections is not a "least squares" analysis. The "best fit" procedure of Byun et al would not be applied to the statics shifts of Ruehle. Byun does not disclose a "least squares" analysis and "least squares" appears nowhere in the text. As practitioners in the art understand, NMO velocity analysis is the geophysicists' art, using skill, judgment, experience and expertise, of choosing a "best fit" curve through a display of contoured data points representing trial values of velocity. The contoured data points are formed from multiple trials of NMO velocities that have had a coherence measure (semblance or correlation) applied. These coherence measure values are contoured and plotted as a function of time versus velocity. A "best fit" line is then selected by the processing geophysicist through the velocities in the display that yield the highest coherence values and that do not seem unreasonable. This is a "best fit" procedure, but not a "least squares" analysis. The NMO velocity evaluation procedure certainly is not an obvious procedure to combine with Ruehle for choosing static corrections for seismic traces.

The Examiner asserts: "it would have been obvious to include source-receiver azimuth in the least squares analysis taught by Crider if that were one of the parameters of interest." While any two data points are amenable to least squares analysis, there must be a motivation to do so—and there is no motivation in the proposed references or their combination why it would be one of the parameters of interest. There is no suggestion or motivation in the prior art of record nor any combination of the prior art of record to form the claimed invention.

The Examiner asserts: "It would have been obvious to one skilled in the art to modify the time-shifted traces disclosed by Ruehle to include performing an amplitude variation based on incidence angle as taught by Crider in order to remove unwanted reflections from the data." We would submit that since Crider already claims to remove unwanted reflections from the data, there is

no motivation in Crider for the combination of using time shifted traces to do so. Ruehle, directed to static corrected seismic records which improves reflections as opposed to removing reflections, includes nothing about amplitude variation based on incidence angle. There is no reason to combine these references, and the references themselves contain no motivation or suggestion to do so.

The Examiner asserts: "It would have been obvious to modify Ruehle to include performing a least squares analysis process with the estimated time shifts used to calculate amplitude variation with incidence angle data as taught by Crider in order to obtain best fit values for the data." There is no reason to modify Ruehle using a least squares analysis process with the estimated time shifts used to calculate amplitude variation with incidence angle data as taught by Crider et al in order to obtain best fit values for the data. There is no suggestion in either reference that obtaining best fit values for data is a goal in itself to be achieved or what the purpose of best values would be. Ruehle is directed to statics corrections which have nothing to do with amplitude variations with incidence angle. Crider et al is directed to AVO analysis to help locate exploration targets using unstacked data. There is no reason to combine these references, and the references themselves contain no motivation or suggestion to do so.

Claim 17 is allowable for at least the reasons Claim 1 is allowable. The prior art of record and any proposed combinations of Ruehle, Crider and Byun et al fails to teach or suggest all the limitations of the claimed invention. It would not be obvious to combine Ruehle, Crider and Byun to form Claim 17 or Claim 18. Accordingly, Applicant respectfully submits that Claim 17 and Claim 18 are allowable.

Claims 13 and 15 are rejected under 35 USC § 103(a) as being unpatentable over Thompson et al. in view of Herkenhoff et al and further in view of "Variation of P-Wave Reflectivity with Offset and Azimuth in Anisotropic Media", Ruger (Referred hereafter as Ruger).

Referring to claim 13, the Examiner's position is

> Thompson et al. discloses a method for processing seismic data to estimate time shift resulting from velocity anisotropy in the earth's subsurface, comprising: (a) forming a gather of seismic data traces; (a) forming a pilot trace by combining a selected

plurality of the seismic data traces within a selected time window (col. 21, lines 35-36); (c) cross-correlating a selected seismic data trace included in the gather with the pilot trace to estimate the time shift in the selected seismic data trace resulting from velocity anisotropy in the earth's subsurface (col. 4, lines 22-32; col. 21, lines 40-42; figures 6 and 10-11); repeating steps (a) and (c) until all seismic data traces within the gather have been cross-correlated with a pilot trace (figures 6 and 10-11); and adjusting each selected seismic data trace by the amount of the estimated time shift in each selected seismic data trace resulting from velocity anisotropy (col. 28, lines 1-3; figures 6 and 10-11).

Further the Examiner's position is that: Thompson et al. does not disclose a method for processing seismic data, comprising determining the incidence angle for each selected data trace and applying a least squares analysis process to reflection coefficient, source-receiver azimuth angle and incidence angle data of the seismic data traces to calculate the amplitude variation with azimuth and amplitude variation with offset in seismic data traces included in the gather.

Further the Examiner's position is that: Herkenhoff et al. discloses a method for processing seismic data, comprising determining the incidence angle for each selected seismic data traces (figures 2-4); and applying a least squares analysis process to reflection coefficient and incidence angle data of the seismic data traces to calculate the amplitude variation with offset in seismic data traces included in the gather (col. 3, lines 37-65; figures 7-8 and 10A-10B).

Further the Examiner's position is that: Herkenhoff et al. does not disclose a method for processing seismic data, comprising applying a least squares analysis process to reflection coefficient and source-receiver azimuth angle to calculate the amplitude variation with azimuth in seismic data traces included in the gather.

Further the Examiner's position is that: Ruger discloses a method for processing seismic data, comprising applying a least squares analysis process to reflection coefficient, source-receiver azimuth angle and incidence angle data of the seismic data traces to calculate the amplitude variation with azimuth in seismic data traces included in the gather (page 937, equations 1, 2, and 5; figures 1, 2, and 3 on pages 937-939). Accordingly, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have applied the least squares analysis process to reflection coefficient, source-receiver azimuth angle and incidence angle data of the seismic traces to calculate the amplitude variation with azimuth as described in the Ruger reference and the amplitude variation with offset as described in the Herkenhoff et al. reference in seismic data traces included in the gather into the method of Thompson et al to improve locating the positions of the reflecting

interfaces indicative of potential oil reservoirs or other geological phenomenon of interest.

As regards Thompson et al, Thompson et al discloses a method for correcting seismic data for phase distortion due to effects of the near surface layer. Contrary to Examiner's assertion, Thompson et al does not disclose a method for processing seismic data to estimate time shift resulting from velocity anisotropy in the earth's subsurface. "Anisotropy appears nowhere in Thompson et al. Thompson et al states that it is an object of the invention to provide a method and automated system for determining and applying phase correction to seismic survey signal records to account for the phase distortion of the near-surface layer (Col. 3, lines 56-59). Phase distortion of the near surface layer is not velocity anisotropy.

As to Herkenhoff et al: Herkenhoff et al does not disclose a method for processing seismic data comprising determining the incidence angle for each selected seismic data traces and applying a least squares analysis process to reflection coefficient and incidence angle data of the seismic data traces to calculate the amplitude variation with offset in seismic data traces included in the gather. Herkenhoff et al does not disclose performing an amplitude variation with incidence angle analysis on adjusted seismic data traces (Fig. 3, 4, 7, 8). Herkenhoff et al direct their disclosure to a method of determining variations in amplitude over source to receiver offsets (see Col. 10, lines 35-65). Herkenhoff et al speak to the **theoretical** reasons that amplitude variations with offset occur and their Figures 3 and 4 illustrate theoretical models. The theoretical model suggests that an amplitude variation with incidence angle effect should occur. (This is similar to Ruger in that it is a theoretical explanation of what may be manifested in actual data. Predictions may result from analysis of models and modeled data.) Herkenhoff et al use the theory that this amplitude variation with incidence angle effect should manifest as a variation with amplitude over different offset ranges. Their teaching of data analysis is directed only to amplitude variation with offset. They teach nothing about analyzing incidence angles in actual seismic data. Herkenhoff et mention angle of incidence for the last time in Column 7 line 61, and this is before they teach their invention.

Ruger does not disclose any method for processing seismic data. Ruger describes how

seismic data should behave based on model equations. Ruger perturbs equations to study seismic behavior in mathematical anisotropic models (page 937).

Thompson is directed to surface statics problems. Neither Herkenhoff nor Ruger would be combined with Thompson et al to address surface statics problems. Herkenhoff is directed to amplitude versus offset effects only (NOT determining incidence angles or reflection coefficients on actual seismic data). Amplitude versus offset behavior has no obvious application to Thompson et al's surface statics. Ruger is directed to an analysis of seismic data behavior in mathematical anisotropic models. The mathematical analysis of P-wave reflectivity in anisotropic models has no application to Thompson et al.

The prior art of record and any proposed combinations of Thompson et al, Herkenhoff et al and Ruger fails to teach or suggest all the limitations of the claimed invention. It would not be obvious to combine Thompson et al, Herkenhoff et al and Ruger to form Claim 13. Accordingly, Applicant respectfully submits that Claim 13 is allowable.

As to claim 15, the Examiner's position is

> Thompson et al. Herkenhoff et al./Ruger do not disclose a method for processing seismic data comprising utilizing a least squares analysis to estimate errors associated with the calculation of amplitude variation in the selected seismic data traces. However, it would have been obvious one-having ordinary skill in the art at the time the invention was made to have utilized a least squares analysis to estimate errors associated with the calculation of amplitude variation in the selected seismic data traces for having a more accurate approximation in calculating the amplitude variation to eliminate the numbers of calculations to cut cost and save time.

Claim 15 is allowable for at least the reasons Claim 13 is allowable. The prior art of record and any proposed combinations of Thompson et al, Herkenhoff et al and Ruger fails to teach or suggest all the limitations of the claimed invention. It would not be obvious to combine Thompson et al, Herkenhoff et al and Ruger to form Claim 15. Accordingly, Applicant respectfully submits that Claim 15 is allowable.

Claims 14 and 16-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over

Thompson et al. in view of Byun et al.

Referring to claim 14, the Examiner's position is that:

> Thompson et al. discloses a method for processing seismic data, comprising: (a) forming a gather of seismic data traces; (a) forming a pilot trace by combining a selected plurality of the seismic data traces within a selected time window (col. 21, lines 35-36); (c) cross-correlating a selected seismic data trace included in the gather with the pilot trace to estimate the time shift in the selected seismic data trace resulting from velocity anisotropy in the earth's subsurface (col. 4, lines 22-32; col. 21, lines 40-42; figures 6 and 10-11); repeating steps (b) and (c) until all seismic data traces with the gather have been cross-correlated with a pilot trace (figures 6 and 10-11).
>
> Further the Examiner's position is that: Thompson et al does not disclose a method for processing seismic data comprising applying a least squares analysis process to the time shifts of the seismic data traces to calculate the velocity variation with azimuth in seismic data traces included in the gather.
>
> Further the Examiner's position is that: Byun et al. discloses a method for processing seismic data comprising applying a least squares analysis process to the time shifts of the seismic data traces to calculate the velocity variation with azimuth in seismic data traces included in the gather (col. 7, lines 51-67; and col. 8, lines 1-4).
>
> Further the Examiner's position is that: Accordingly, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have applied a least squares analysis process to the time shifts of the seismic data traces to calculate the velocity variation with azimuth in seismic data traces included in the gather as described in the Byun et al. reference into the method of Thompson et al. to improve estimating velocity and dip for each of the subsurface layers to identify gaseous hydrocarbon containing formations and referring changes in the geological character of the formations in seismic exploration.

As Applicant has respectfully pointed above with respect to Claim 17 and Claim 18, Byun teaches nothing about least squares analysis and "least squares" nowhere appears in the reference. The prior art of record and any proposed combinations of Thompson et al and Byun fails to teach or suggest all the limitations of the claimed invention. It would not be obvious to combine Thompson et al and Byun to form Claim 14. Accordingly, Applicant respectfully submits that Claim 14 is allowable.

As to claims 16-17, is the Examiner's position is that:

> Thompson et al/Byun et al. do not disclose a method for processing seismic data further comprising utilizing a least squares analysis to estimate errors associated with the calculation of time shift variation and velocity variation in the selected seismic data traces. However, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have utilized a least squares analysis to estimate errors associated with the calculation of time shift and velocity variations in the selected seismic data traces for having a more accurate approximation in calculating the velocity variation to eliminate the numbers of calculations to cut cost and save time.

Claims 16 and 17 are allowable for at least the reasons Claim 14 is allowable. The prior art of record and any proposed combinations of Thompson et al and Byun et al fails to teach or suggest all the limitations of the claimed invention. It would not be obvious to combine Thompson et al and Byun et al to form Claims 16 and 17. Accordingly, Applicant respectfully submits that Claim 13 is allowable.

CONCLUSION

For all the foregoing reasons, Applicant submits that the application is in a condition for allowance. No fee is believed due for this paper. The Commissioner is hereby authorized to charge any additional fees or credit any overpayment to Deposit Account No. **13-0010 (IO-1095US-D1)**.

Respectfully submitted,

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